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REMARKS

Applicants have canceled previously withdrawn claims 1 – 11 and 16 – 18. They present claims 12 – 15 plus new dependent claims 19 – 22.

Claim 13 stands rejected under 35 USC 112 as reciting a method dependent on an apparatus claim 12. Applicants have amended claim 13 to recite an apparatus, and they request that this rejection be withdrawn.

Claims 12 and 14 are rejected under 35 USC 102(b) as being anticipated by US 5148265 to Khandros et al. While not agreeing entirely with this rejection, applicants have amended independent claim 12 to more particularly point out and distinctly claim their invention.

Applicants' invention solves a problem of surface mount components attached by terminals to a patterned layer of a circuit board with solder (or cured conductive adhesive) joints between the terminals of the surface mount components and the patterned conductive layer. This problem is lateral stress induced failure of the joints due to thermal cycling, since portions of the assembly have different rates of thermal expansion and contraction in the lateral direction. Applicants' inventive structure includes, over the substrate and a first patterned conductive layer thereon, a compliant layer and, over this, a second patterned conductive layer to which the surface mount component terminals are coupled. The second patterned conductive layer has interconnects extending essentially perpendicularly through the compliant layer to couple with the first patterned conductive layer and are themselves sufficiently flexible laterally to allow, along with the compliant layer, relative lateral movement between the terminals of the surface mount device and the patterned conductive layer and thus substantially reduce the lateral stresses on the joints between the terminals of the surface mount device and the second patterned conductive layer to greatly extend the life expectancy of the assembly when subject to thermal cycling.

In a broader view of the problem, a producer of component populated circuit boards generally buys many different kinds of components for the boards from different component manufacturers. While it is possible for the populated circuit board producer to alternatively minimize these thermal stresses by specifying to customer component manufacturers a specific component substrate material having a modulus that results in a close thermal expansion/contraction motion by the substrate and first conductive layer of the circuit board, this greatly restricts the manufacturer's choice of component suppliers and complicates the design and purchasing processes. For example, one manufacturer may make a component with a plastic circuit board while another makes a competing component with a ceramic circuit board. It is desirable for the populated circuit board manufacturer to have the power to choose between these two components on factors such as price, quality, delivery, etc. rather than being restricted by a need to match coefficients of thermal expansion; and applicants' invention enables this by eliminating differing thermal expansion as a required consideration.

The Khandros et al disclosure is not concerned with this problem and does not disclose applicants' structure for dealing with it. Rather, it adds an "interposer" comprising a lower layer 40 and an upper layer 38. Lower layer 40 is a low modulus (compliant) material and is divided into separated, compliant supports 43. Upper layer 38, although thin to allow vertical flexing, is made of a high modulus material and is relatively non-compliant in the lateral direction. The purpose of the interposer is to flexibly permit relative vertical movements (perpendicular to the lateral direction) of different contact members 48 to accommodate slightly different lengths of electrical test probes 62 in a board testing device 65 so that all will achieve good physical and electrical contact for test purposes. Specifically, upper layer 38 of the interposer, being relatively non-compliant laterally, will itself dictate the relative lateral movements of the terminals 48 relative to corresponding terminals of a surface mount device

according to its own coefficient of thermal expansion and will not provide the lateral compliance required to reduce thermal stress failure of the solder of thermal adhesive joints (such as joints 70 in Figure 5) with corresponding terminals of a surface mount device. Upper layer 38 effectively cancels any lateral compliance of lower, compliant layer 43, and the teaching of Khandros et al is thus completely inconsistent with applicants' invention. Applicants have captured this difference in their recitations:

> ...a second patterned conductive layer having a lateral first surface coupled to the second surface of the compliant layer with no intervening layer that is significantly less compliant than the compliant layer....

This recitation is inconsistent with element 38 of Khandros et al, since it recites a second patterned conductive layer with a lateral first surface coupled to the second surface of the compliant layer (rather than to a high modulus layer such as layer 38 of Khandros et al) and further positively states that there is no intervening, less compliant layer, corresponding to the Khandros et al layer 38.

In the Office action rejection of claim 12 based on 102(b), Examiner stated that Khandros et al teach "an interconnect 56 coupled to the compliant layer...." But Examiner previously states that the "compliant layer" of applicants' claim 12 was considered for this claim reading to be "compliant layer 40." Applicants point out that interconnect 56 is connected between terminals 30 and 48, neither of which is compliant or has any contact with compliant layer 40. Furthermore, interconnect 56 is, except for these contacts, completely immersed and surrounded in layer 58, which, although disclosed as being compliant (having a low modulus), is, in structure, an identifiably separate layer from layer 40: made of a separate material and deposited in a different operation. Applicant uses the term "layer" in the manner standard in the art of semiconductor device manufacture: that is, a deposit of a material over a

horizontal area or areas of a substrate at one time (with other operations used to determine the precise area by removal of portions of the layer. An inspection of the device of Figure 4 (or 5) shows that layer 58 overlaps a stack of intervening layers (conductive layer 48 and high modulus layer 38) covering compliant layer 40; and this proves that it was deposited as a separate layer after layer 40 and the intervening layers 48 and 38. It is therefore, in the relevant art, an identifiably separate layer. Thus, Examiner's statement fails to support the anticipation rejection, even before applicants' amendment. But, in addition, applicant has amended claim 12 to recite that the compliant layer comprises "a single, homogeneous material." This means that the compliant layer is a single layer of a material having a consistent modulus throughout the layer. There is no clear teaching in Khandros et al that layers 58 and 40 have the same modulus; and, since they have different purposes (protection of interconnects 56 by layer 58 and vertical compliance to permit vertical, it is unlikely that they do, since the modulus of each can and would be selected to optimize its own performance relative to its own purpose in the assembly.

Applicants have further amend claim 12 to recite that the second patterned conductive layer further comprises:

> ... a plurality of interconnect portions extending substantially perpendicularly from the first surface thereof through the compliant layer to couple with portions of the first patterned conductive layer...

This means that (1) the interconnect portions are structurally part of the second conductive layer, (2) the interconnect portions extend through the compliant layer, and (3) the interconnect portions extend in a substantially perpendicular manner toward the first patterned conductive layer and couple with portions thereof. Although the connecting function of these interconnect portions is similar to the interconnect wires 56 of Khandros et al, their structure is quite different and better suited to efficient manufacture while accommodating

differences in lateral stresses on the first and second surfaces of the compliant layer. (The interconnect portions are made sufficiently thin that they flex as required for this accommodation. Their width is exaggerated in the drawings for convenience, and in any case is determined by specific design considerations in any particular application.)

This arrangement is quite different in many respects from that shown in Khandros et al, wherein the interconnects are separate wires that are wire bonded at each end and extend through a different compliant layer from that recited in applicants' claim. To name one particular structural advantage, applicants' interconnect portions are well protected within the single compliant layer between the first patterned conductive layer and the main, lateral portion of the second patterned conductive layer without need for Khandros' additional compliant layer 58 for protection in handling.

Applicants' new claims 19 and 20 are species claims depending on claim 12 and reciting that the "attachment material" used to fixedly attach the surface mount component terminals to portions of the second conductive layer is solder or electrically conductive adhesive, respectively. Each of these substances is described in applicants' specification as usable embodiments. Applicants' new claims 21 and 22 are species of claim 14 but further reciting modulus ranges.

Applicants assert that the Khandros et al reference does not anticipate their claimed invention. Khandros et al show a different structure with a different purpose, being oriented toward vertical movements of terminals to accommodate test probes of slightly varying length, while applicants' claimed invention is oriented toward lateral movements of terminals due to the differing thermal expansions of the substrates on which terminals are mounted and the need to reduce the joint destroying lateral stresses produced in thermal cycling. In addition, the inclusion of element 38 in Khandros et al is totally inconsistent with applicants' invention and teaches away from it. Khandros et al is no support

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for either the anticipation or obviousness rejections of applicants' claims, which appear to be in condition for allowance.

Please charge any deficiencies and credit any overpayment to Deposit Account No. 50-0831.

Respectfully submitted,

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